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(54) A METHOD FOR THE PRODUCTION OF A COATED PATTERNED PAPER SUPPORT FOR INCORPORATION IN A PHOTOGRAPHIC PAPER

(71) We, FUJI PHOTO FILM CO., LTD., a Japanese Company, of No. 210, Nakanuma, Minami/Ashigara-Shi, Kanagawa, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method for the production of a coated, patterned paper support for incorporation in a photographic paper.

Various techniques are known for producing photographic papers with a pattern or texture on the surface of the paper. One technique comprises applying a pattern after all photographic processings such as development and fixation have been completed. However, this technique is unsuitable for treating large quantities of material, and also involves a high cost of production from the standpoint of the speed of treatment and the treating apparatus. Another technique involves applying a pattern or texture to the photographic paper itself. One method in which this technique is employed comprises applying a pattern to a support before the coating of a photographic emulsion thereon, and another method in which this technique is employed comprises applying a pattern after coating a photographic emulsion on the support (see Patent Specification No. 1,352,337). The latter method presents a number of production difficulties because a physical force is exerted on the surface of the emulsion layer and the application of the pattern must be performed in a darkroom. For this reason, in order to produce a photographic paper with a given surface texture, it is convenient to employ a technique which involves coating a photographic emulsion on a support to which the texture has been applied.

In recent years, resin coated papers obtained by coating both surfaces of a paper with polyethylene have come into widespread use in place of conventional baryta paper. The formation of a polyethylene coating is generally effected by an extrusion coating method. In order to apply a pattern to a resin-coated paper, an embossing calender having depressed and raised portions with a depth of 50 microns to 2 millimeters is generally used. However, an extra step is required in this method when a pattern is to be applied to a coated paper having a cooled resin surface, after the polyethylene coating, and this inevitably increases the cost of production. Furthermore, the depth of the pattern changes depending on the calendering pressure, the thickness of the resin layer, etc., and the pattern tends to become non-uniform. In addition, since the calendering pressure is as high as 50 to 300 Kg/cm, creases tend to occur.

The present invention provides a method for producing a support for use in a photographic paper by extrusion-coating a polyolefin onto paper, which comprises extrusion-coating a layer of a polyolefin on at least one surface of the paper support and bringing said layer into contact with a cooling roll of which the surface is engraved with a pattern to a depth of not more than 40 microns and preferably is matte-finished, the thickness of the polyolefin layer being adjusted to at least 1.1 times the depth of the engraving in the surface of the cooling roll, whereby the pattern is applied to the surface of the polyolefin layer simultaneously with the extrusion-coating.

The invention is illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a diagram illustrating an extrusion coating method in accordance with this invention,

Figs. 2 to 4 show the form of engravings in

the engraved roll in relation to the pattern on the surface of a resin-coated paper; Fig. 2 showing an engraving depth of 120 microns; Fig. 3 showing an engraving depth of 25 microns; and Fig. 4 showing an engraving depth of 10 to 15 microns with a matte-finish, and

Fig. 5 is a graph which shows the photographic characteristics of photographic papers obtained in Examples 1 and 2 below.

In the drawings, numeral 1 represents a paper support; 2, polyethylene; 3, an engraved cooling roll; 4, a nip roll; and 5, a die. In Fig. 5, curve A refers to the photographic characteristics of a photographic paper prepared using a cooling roll whose surface is engraved to a depth of 120 microns; curve B refers to the photographic characteristics of a photographic paper prepared using a roll whose surface is engraved to a depth of 25 microns; and curve T refers to the photographic characteristics of a photographic paper using a flat support. The ordinate indicates the optical density D, and the abscissa indicates the amount of exposure E.

Generally, the depth of the engravings provided in conventional embossing calenders is more than 50 microns, and good results cannot be obtained if such a roll is used as a cooling roll in extrusion coating. Because the engravings are too deep, the polyolefin resin does not completely enter the depressed portions of the engravings. Furthermore, non-uniformity occurs because the depth to which the polyolefin coatings enters the engravings varies according to the thickness of the polyolefin coating. Alternatively, the pressure required for adhesion between the paper and the resin layer is not exerted at the time of extrusion coating, and therefore, the bond strength becomes poor. In addition, since the pattern on the surface of the resin coated paper is deep, when the resin coated paper is used as a paper support for a photographic emulsion, air is entrained in the depressed parts of the pattern during the coating of a photographic emulsion on the resin coated paper, and uniform coating is extremely difficult.

Another disadvantage is that since a photographic paper obtained by coating a photographic emulsion on such a support has a high degree of surface uneveness, when an image is printed thereon, the density of the image is reduced and the surface gloss also disappears.

On investigation of the relationship between the depth of the engravings and the thickness of the resin layer extrusion-coated on a paper, it has now been found that the desired pattern can be completely transferred if the depth of the engravings is limited to not more than 40 microns, preferably 10 to 25 microns, and the thickness of the polyolefin coated layer is adjusted to preferably at least 1.2 times the depth of the engravings.

When the depth of engravings is above 40 microns, especially above 50 microns, the above-described defects occur, and when the depth is below about 8 microns, the significance of applying a pattern is reduced.

With some patterns, air is sometimes entrained even when the depth of the engravings is shallow, and distortion may occur in the pattern. It has been found that by matte-finishing the engravings, air can escape more easily, and the pattern can be transferred completely. The surface so obtained permits the uniform coating of an emulsion which has been difficult with the conventional techniques, and no photographic problems occur.

The depth of the engravings on the resin-coated paper produced using a cooling roller whose surface is engraved to the above-described depth is substantially the same as the depth of the engravings on the roll because the impressions of the engravings have been completely transferred. Resin-coated papers with impressions of engravings of such a depth can be processed under the same conditions on the same equipment as in the case of resin-coated papers with a flat surface in rendering the polyolefin surface hydrophilic and in coating a photographic emulsion. A decrease in the density of images at the time of printing using photographic papers prepared by coating a photographic emulsion on the resin-coated papers does not occur and the gloss of paper can be controlled over a wide range by controlling the coarseness of the matte-finish to be imparted to the engravings on the cooling roll.

According to the method of this invention, a design can be applied at the same time as the extrusion-coating of a polyolefin, especially polyethylene, and the cost of production can be reduced drastically. The resulting patterned photographic paper support is very uniform as compared with conventional photographic paper supports embossed using an embossing calender.

Since according to the method of this invention, the impressions of engravings on the surface of a cooling roll are completely achieved, and the depth of the impressions due to the engravings does not vary according to the embossing pressure, it is merely sufficient to use a cooling roll whose surface has been engraved to the desired depth of the pattern. Production of an engraved roll with an engraving depth of not

more than 40 microns, for example, 10 to 25 microns, generally requires a far higher level of skill than the production of engraved rolls with an engraving depth of more than 40 microns. Accordingly, sufficient care is needed for the production of engraved rolls. The matte-finish can be accomplished, for example, by using a sand blasting technique which provides a surface roughness of about 2 to 5 microns. When the thickness of the polyolefin coating is small as compared with the depth of engravings, the polyolefin is unlikely to enter the depressed parts of the engravings completely. In order to obtain a uniform pattern, the thickness of the polyethylene layer should be adjusted to at least 1.1 times, especially at least 1.2 times, the depth of the engravings. Theoretically, a suitable depth of the polyolefin coating is at least equal to the depth of the engravings. Surprisingly, however, the transfer of patterns or the bond strength is not sufficient when the thickness of the polyolefin layer is about the same as the depth of the engravings. When the thickness of the polyolefin layer is too large, there is no serious problem. However, in view of the cost of production, the thickness of the polyolefin layer should preferably be restricted to about 5 times the depth of the engravings.

When a cooling roll whose surface has been engraved with a pattern is used in accordance with the present invention, raised and depressed portions are provided while the resin layer is still in a soft condition, and therefore, a very low embossing pressure can be used. In other words, sufficient effects can be obtained at an embossing pressure of not more than 30 Kg/cm, for example 25 to 10 Kg/cm.

A sufficient embossing time is 5 seconds or less, for example, 1 to 3 seconds. These values can be varied according to the temperature of the resin to be coated, or the temperature of the cooling roll.

Extrusion coating of a polyolefin onto a paper support is well known. Suitable polyolefins that can be used are homo- or co-polymers of α-olefins containing 2 to 8 carbon atoms, such as ethylene or propylene, and copolymers of α-olefins with other monomers copolymerizable therewith, such as ethylene vinyl acetate copolymers. Of the polyolefins, polyethylenes having a melt index of 1.5 to 20 and density of 0.912 to 0.965 g/cm^3 are particularly preferred.

The polyolefin may be extruded onto both surfaces of the paper support at 290°C to 330°C in accordance with conventional methods. If desired, a number of layers can be extruded.

The temperature of the cooling roll used in the present invention can be set as desired in the range of from 4 to 30°C. In conventional methods, the peeling ability between the cooling roll and a polyolefin is poor when the temperature of the cooling roll is set at 15 to 30°C. However, in contrast, the peeling ability thereof in the present invention is good where the temperature of the cooling roll is set at 15 to 30°C.

The paper support, as referred to herein, can be any material consisting substantially of paper, and the paper employed may contain synthetic fibre pulp.

It is well known that an extruded polyolefin layer can contain a pigment such as titanium dioxide, an antistatic agent, or a fluorescent bleaching agent and such materials can also be present in the polyolefin resin extruded in the method of the invention as well.

Needless to say, the paper support can be subjected to any known surface treatment before the coating of an emulsion layer. Suitable emulsion layers which can be coated include conventional emulsion layers such as silver halide emulsion layers, diffusion transfer image-receiving layers, or organic photo-sensitive layers.

The method of this invention is illustrated in greater detail by reference to the following Examples, of which Example 1 is provided for comparison and is not in accordance with the invention.

Example 1.

Polyethylene was extrusion-coated in a thickness of 40 microns on high quality paper having a basis weight of 170 gm/m^2 using a cooling roll whose surface was engraved to a depth of 120 microns to form a resin-coated paper. The coating rate was 50 m/min., the resin extrusion temperature was 310°C, and the nip pressure was 25 Kg/cm. The depth of the pattern on the surface of the resin-coated paper was 50 to 60 microns. The pattern of the engraved roll was not completely transferred. This condition is shown in Fig. 2 of the accompanying drawings. The bond strength between the polyethylene layer and the paper was such that they could be easily separated by hand. The surface of the resin-coated layer was subjected to a corona discharge to render it hydrophilic, and then a photographic emulsion was coated thereon. When a photographic emulsion was coated on the thus coated paper, air bubbles were entrained in the depressed portions of the pattern, and the photographic emulsion was not coated on these portions.

The photosensitive characteristics of this photographic paper (after coating of the photographic emulsion) were as shown in curve A of Fig. 5. As compared with the case of using a smooth support (T), the

density of the image was reduced to a great extent, and the gloss of the surface completely disappeared.

Example 2.

A resin-coated paper was produced under the same conditions as in Example 1 using a cooling roll whose surface was engraved to a depth of 25 microns. The resin-coated paper was subjected to a corona discharge treatment, and coated with a photographic emulsion.

The pattern on the surface of the resin-coated paper was substantially in agreement with the form of the engravings on the cooling roll. Air did not completely escape, but small depressions were seen on the top of the pattern. This condition is shown in Fig. 3. When a photographic emulsion was coated, no air bubbles were entrained. The photographic characteristics of the photographic paper in accordance with this Example were as shown in Fig. 5, B, and were almost the same as those obtained when a flat support (T) was employed. The gloss of the surface of the photographic paper was quite high, but some glittering was observed.

Example 3.

Using a roll whose surface was engraved to a depth of 10 to 15 microns which was matte-finished in 200 mesh (with an average size of about 3 microns), a resin-coated paper was produced under the same conditions as in Examples 1 and 2. After corona discharge, a photographic emulsion was coated on the resin-coated paper.

The engraved impression of the engraved roll was completely transferred to the surface of the resin-coated paper, and no depression due to the entraining of gas bubbles was observed. At the time of coating the photographic emulsion, no entraining of gas bubbles occurred. The photographic characteristics of the photographic papers in this Example were almost the same as those in Example 2. The surface of the photographic paper had a moderate glass, and no unevenness or glittering was observed.

WHAT WE CLAIM IS:—

1. A method for producing a support for use in a photographic paper by extrusion-coating of a polyolefin onto paper, which comprises extrusion-coating a layer of a polyolefin on at least one surface of the paper support and bringing said layer into contact with a cooling roll of which the surface is engraved with a pattern to a depth of not more than 40 microns, the thickness of the polyolefin coated layer being adjusted to at least 1.1 times the depth of the engraving in the surface of the cooling roll, whereby the pattern is applied to the surface of the polyolefin layer simultaneously with the extrusion coating.

2. A method as claimed in Claim 1, wherein the depth of the engraving in the surface of the cooling roll is 10 to 25 microns.

3. A method as claimed in Claim 1 or 2, wherein said polyolefin is a polyolefin homopolymer, a copolymer of olefin monomers or a copolymer of an olefin monomer with another monomer copolymerizable therewith.

4. A method as claimed in any one of Claims 1—3, wherein the surface of said cooling roll is also a matte-finished surface.

5. A method as claimed in any one of Claims 1—4, wherein the thickness of the polyolefin layer is at least 1.2 times the depth of the engraving of the surface of the cooling roll.

6. A method as claimed in Claim 3, wherein said polyolefin is polyethylene.

7. A method as claimed in Claim 6, wherein said polyethylene has a melt index of 1.5 to 20 and a density of 0.912 to 0.965 g/cm^3.

8. A method as claimed in any one of Claims 1—7, wherein the temperature of the cooling roll ranges from 4 to 30°C.

9. A method as claimed in any one of Claims 1—8, wherein a photographic layer is coated on the patterned surface of said support, to form a photographic element.

10. A method as claimed in Claim 9, wherein said photographic layer is a silver halide emulsion layer.

11. A method as claimed in Claim 9, wherein said photographic layer is a diffusion transfer image receiving layer.

12. A method as claimed in Claim 9, wherein said photographic layer is an organic photosensitive layer.

13. A method as claimed in Claim 1, substantially as described in Example 2 or 3 herein.

14. A paper support when produced by the method of any one of Claims 1—8 or 13.

15. A photographic paper when produced by the method as claimed in any one of Claims 9—13.

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